REMARKS

Claims 1 has been amended to include the limitation of claim 8, which is hereby canceled. Claim 21 were amended to include the limitation that the super-buoyant particle size is within the range of 0.1 micron and 1.0 mm. This size range is provided in canceled claim 8. Additionally, this range is disclosed in paragraph [0077], which discloses a diameter between 0.1 microns and 25.4 mm. Claims 4 and 5 have been canceled. Claim 35 has been amended to remove the limitation relating to the specific size of the particles.

Claims 1-3, 7, 21, 22, 25 and 36 stand rejected under 35 U.S.C. 102(b) as being anticipated by Iwatani, 4,198,301. Claim 1 and claim 21 have been amended to include the limitation that the super-buoyant particle size is within a range of 0.1 micron and 1.0 mm. The Iwatani reference does not specify the size of the filter medium nor does this reference suggest a size within the range claimed by the Application. Because of the design information disclosed in Iwatani, Applicant submits that one of ordinary skill in the art would not be motivated to use super-buoyant particles within a range of 0.1 micron and 1.0 mm with the technology disclosed in Iwatani. As discussed in greater detail below, the extremely small size claimed in the present application has several limitations that must be overcome in order to provide a useful filtration process and apparatus. One particular limitation related to super-buoyant particles of the size and specific gravity claimed is the formation of clumps due to the contaminants that fill the interstices between the media particles. These clumps can lead to the formation of channels which reduce the efficiency of the overall system. It is not simply a matter of engineering design depending on the specific liquid filtered and results desired when determining the appropriate size of the super-buoyant particles. As discussed further below, smaller super-buoyant particles

have several disadvantages that are not found in larger buoyant material. Therefore, Applicant submits that this rejection is overcome and requests reconsideration and allowance of the claims.

Claim 23 stands rejected under 35 U.S.C. 103(a) as being unpatenable over Iwatani, 4,198,301. Because of the amendment to claim 21, Applicant submits that this rejection is overcome and requests reconsideration and allowance of the claim.

Claims 4, 5, 8, 9, 32, 33 and 35 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Iwatani, and further in view of Hsiung, 4,608,181. The present invention is directed to a process filtration apparatus embodying a specific filter bed for removing particulates from a process liquid. The need to remove particulates from process liquids is common to a wide range of processes. One conventional process for removing particulate contaminants from a process liquid includes the use of small non-buoyant particles such as sand or diatomaceous earth. The sand and diatomaceous earth particles are small in size, such as 0.35 mm and 100 microns in diameter, respectively. However, both sand and diatomaceous earth particles are substantially heavier than the process liquid to be filtered. So, the media particles sink to the bottom of the filtration vessel forming a bed of filter media. During processing, the process liquid flows through this bed of filter media until the pressure required to force liquid through the bed increases, and provides an indication for the need to clean the accumulated particles. Cleansing is achieved by a process of backwashing, whereby clean liquid is vigorously pumped upwards from the bottom of the particulate bed. Although sand and diatomaceous earth filters have been successfully applied to a wide variety of filtration problems, this method of filtration has several known disadvantages. One of the most serious problems involves

maintaining bed homogeneity during operation. Inhomogeneities in the bed, such as cracks, offer a region of less flow resistance resulting in the formation of channels in the bed. If channels are formed, the amount of particulate removal is drastically decreased. Additionally, the size and cleanliness of the bed particles is extremely important. A bed composed of large particles allows significant numbers of small particulates to pass through the filter bed along with the process liquid. On the other hand, beds composed of smaller particles can quickly become clogged with small contaminant particles. To maintain cleanliness, large volumes of clean liquid are required to backwash and clean conventional filter beds, leading to large volumes of contaminated liquid which must be properly treated and disposed. Thus, one of the crucial problems with these conventional systems, which is common knowledge to practitioners in the art, is the ineffectiveness of backwash systems for cleaning the filter media. As a consequence, in many situations, the contaminated bed cannot be cleaned and instead must be replaced with new bed material. An alternative method for bed filtration uses a filter bed composed of buoyant filter media particles. In this method, filter media form a bed in which the majority of the media floats just beneath the surface of the process liquid. The process liquid is pumped into the bottom of the filter chamber and flows vertically upward through the bed. The buoyant media particles used in this type of application are of a larger diameter than the media particles used in either sand or diatomaceous earth filters. For example, the Hsiung reference specifies a particle diameter as being in the range of 1.5 to 20 mm. Because of the design of the system in Iwatani, Applicant submits that the size of the buoyant particles in Iwatani is similar to the size of the particles in Hsiung. Due to this relatively large size, these buoyant media filter beds are not optimized to remove small particulate contaminants. One of ordinary skill in the art would not

be motivated to use super-buoyant particles within the size range claimed by the present application, for a variety of reasons. First, the problems encountered in using small diameter non-buoyant media, such as sand and diatomaceous earth, are exacerbated when using small diameter buoyant media. Due to the high surface area of the small diameter media, contaminant particles that fill the interstices between the media particles can act like a glue which makes the media particles adhere to one another and form clumps which lead to the formation of non-homogeneities within the bed. In the case of small diameter buoyant media, the light weight of the media particles makes it even more difficult to break these clumps apart to clean the media particles. Because the backwash systems previously used in systems including buoyant particles, such as the Hsuing and Iwatani, are relatively gentle in nature, these non-homogeneities cannot be removed from the bed, and the bed performance declines. This problem dictates that small diameter filter media not be used in buoyant media application, because the backwash process itself severely limits the efficacy of the filter bed. Thus, although such buoyant filters have desirable characteristics for specific filtration applications, they do not overcome the above-stated disadvantages of conventional media bed filters. The unique and novel backwash system claimed in co-pending application serial number 11/044,592 provides a sufficiently rigorous method of breaking up these clumps, efficiently washing the contaminant particles off the media particles, and returning the bed to a very clean state which contains no clumps. Furthermore, super-buoyant particles having an extremely small size provide for a significantly larger surface area of the filter media than the prior art references. The surface area of the filter is not only crucial in determining the capacity of the media to retain contaminants, but also in determining the difficulty of cleaning the media once its capacity has been reached.

Because of the size of the particles in the presently claimed invention, the surface area of the media is nominally 2-20 times greater than the surface area of the media in the prior art. One of the most significant consequences of utilizing small diameter media is the increase in pressure required to pump process fluid through the filter bed. The pressure required to pump process fluid through the filter media in the presently claimed invention ranges from approximately 100 to almost 500 times greater than the pressure required to pump water through the filter described in the Hsiung reference. Another important aspect of the presently claimed invention is the use of super-buoyant particles having a specific gravity lower than one half of the specific gravity of the process liquid. In this regard, the majority of the super-buoyant particles float above the surface of the process liquid. In contract, the Hsuing reference provides buoyant particles having a specific gravity of no less than 0.80. One of ordinary skill in the art would appreciate that differences in buoyancy characteristics, and thus the behavior as a filter medium, of granules with a specific gravity of 0.8 or 0.9 when compared with granules having a specific gravity of 0.5 or less. This higher specific gravity provides that a majority of the particles float beneath the surface of the process liquid. This distinction between filter media that float beneath the surface of the process liquid and filter media primarily floating on the surface of the process liquid is critical in determining the unique operational characteristics of the filter. For example, buoyant media floating beneath the surface of the water behave principally as though they are part of the water mass. Thus any horizontal movement of the water containing such media drags the media along with it. An injection of air bubbles into such a media bed will also move the media particles because they are very close to neutral buoyancy, and this neutral buoyancy renders them easy to move. In contrast, the super-buoyant particles of the present invention do not

behave as though they are part of the process liquid mass. Since the super-buoyant particles float on the surface of the process liquid, they are largely independent of, and isolated from, the movement of the process liquid beneath. Horizontal movement of the liquid beneath the floating super-buoyant media have virtually no effect on the media, and thus such movement do not tend to cause significant movement of the super-buoyant media bed. Due to the significant differences in specific gravity between the media and the process liquid, super-buoyant media produce a highly advantageous means of naturally, gravimetrically separating both clean and contaminated filter media and process liquid into separate "phases". This natural, spontaneous separation is crucial to both sustaining the performance of the filter bed and to maintaining the effectiveness of backwashing such that each back wash cycle produces a reproducibly clean filter bed to insure uniform, predictable filter performance. With regard to claim 9, Applicant submits that neither Hsiung nor Iwatani provide for super-buoyant filter bed particles having a size that require a process fluid pressure of from approximately 20 to 150 psi for process fluid to flow through said filter bed. One of the most significant consequences of utilizing small diameter media is the increase in pressure required to pump process fluid through the filter bed. The Hsiung reference discloses a pressure drop across the cleaned media bed from 0.7 to one foot (0.31 to 0.45 psi). The larger pressure values necessitated by the claimed invention, due to the small particle size of the super-buoyant particles, requires considerable increase in the structural strength of the media retaining mechanism. At the same time, this increase in structural strength must minimally reduce the flow of water through the media. Applicant asserts that neither the Hsiung nor the Iwatani reference teach or suggest the use of two different media in two different filter housings to provide a coarse followed by a fine filter capability as claimed in claim 32 and

claim 33. For the reasons identified above, Applicant submits that the rejection is overcome and request reconsideration and allowance of the claims.

Claims 6, 24, and 29-31 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Iwatani as above, and further in view of Cochrane, 4,211,656. With regard to claim 6, a thorough review of the Cochrane reference teaches, at most, the expansion of non-buoyant media to about 20% during backwashing. The Cochrane reference uses a combination of air and backwash fluid to cause the bed to expand. One of ordinary skill in the art would appreciate the difference between a non-buoyant media and the super-buoyant particles of the presently claimed invention. The expansion in the presently claimed invention uses a high-pressure, solid-cone spray nozzle to expand the bed sufficiently to clean it. Therefore, one would not be motivated to combine the teaching directed to the expansion of a non-buoyant media with the expansion of super-buoyant particles. With regard to claim 24, neither the Iwatani nor the Cochrane reference discloses a means for controlling the process fluid inflow to, and outflow from, to the filter housing in order to successfully use small diameter, super-buoyant media particles. At most, the Cochrane reference and Iwatani reference disclose "overflow" methods for collecting filtrate. This is a very imprecise method for controlling filter effluent. Because of the amendment to independent claim 21, Applicant submits that the rejections of claims 29-31 are overcome. For the foregoing reasons, Applicant submits that the rejection has been overcome and requests reconsideration and allowance of the claims.

Claim 10 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Iwatani as above, and further in view of Daley, 5,178,772. Applicant submits that there is no motivation to combine the teaching of Iwatani with the teachings of Daley. The Iwatani reference does not teach or suggest the desirability of using an ultraviolet reactor. The Examiner has indicated that it is known to utilize an ultraviolet reactor in combination with a filter to aid in removing metal contaminants from aqueous solutions. However, after a thorough review of the Daley reference, it is clear that this reference does not teach or suggest the filter bed described in Iwatani or claimed in the present invention. The Daley reference mentions filtering using a "0.2 micron filter" and samples that are "syringe-filtered". But, clearly this type of filtering would not suggest that the samples in Daley are subjected to the type of filtering disclosed in Iwatani or claimed in the present application. Therefore, Applicant submits that the present rejection is overcome and request reconsideration and allowance of the claim.

Claim 26 stands rejected under 35 U.S.C. 103(a) stands rejected as being unpatentable over Iwatani as above, and further in view of Muller, 4,383,920. Because of the amendment to independent claim 21, Applicant submits that this rejection is overcome and requests reconsideration and allowance of the claim.

Claims 27 and 28 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Iwatani as above, and further in view of Holland, 6,067,653, and Banks, 4,885,083. The independent claim upon which both claims 27 and 28 dependent includes the limitation that the filter media is a super-buoyant particle with a specified specific gravity and size. Since

Applicant has asserted that claim 21 is patentable, Applicant asserts that claims 27 and 28 are likewise patentable. Therefore, Applicant requests reconsideration and allowance of these claims.

Claims 1-5, 7-10, 21-25, 27, 28, and 32-36 stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-4 of U.S. Patent No. 6,638,422. Applicant is prepared to submit a terminal disclaimer to obviate this rejection upon the notification of allowable subject matter.

Claim 26 stands rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-4 of U.S. Patent No. 6,638,422 in view of Muller, 4,383,920. Applicant is prepared to submit a terminal disclaimer to obviate this rejection upon the notification of allowable subject matter.

Claims 6, 24, and 29-31 stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-4 of U.S. Patent No. 6,638,422 in view of Cochrane, 4,211,656. Applicant is prepared to submit a terminal disclaimer to obviate this rejection upon the notification of allowable subject matter.

Because of the amendments to claims 1 and 21 including the limitation that the super-buoyant particles have a size in the range of 0.1 microns and 1.0 mm, Applicant submits that the claims of the application are now in condition for allowance. Therefore, Applicant respectfully requests reconsideration and allowance of the claims.

Respectfully submitted,

By: Jennifer P. Yancy
Jennifer P. Yancy
Reg. No. 47,003

JONES, TULLAR & COOPER, P.C.
P.O. Box 2266 Eads Station
Arlington, VA 22202
(703) 415-1500
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